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# BEHAVIOR OF SINGLE CATS AND GROUPS IN THE HOME

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## THE SOCIAL BEHAVIOR OF WILD AND FERAL CAT GROUPS

Felid Classification: Origins of Behavior

Wild Cat Behavior and Signaling: Evolutionary Precedents

Classic Studies of Feral Cat Behavior

Recent Studies of Feral Cat Behavior and Implications for Cat Behavior in the Home

## SOCIAL BEHAVIOR IN THE HOME

Lessons About Social Behavior from Direct Observation of Pet Cats in the Home:

Intraspecific Interactions

Lessons About Social Behavior from Examination of Human-Cat Interactions in the Home: Interspecific Interactions

## SUMMARY

The estimated total population of cats living as pets in the United States is about 76 million,<sup>1</sup> yet little formal research exists regarding feline behavior in the home. Although a large body of anecdotal literature exists, it is based primarily on the experiences of veterinarians and applied animal behavior practitioners. Few formal scientific studies have been performed. Few studies exist of the social behavior of most wild cat species, either in natural or captive habitats, that could provide an evolutionary basis for understanding domestic cat behavior. However, studies of feral cat colonies, which provide us with a picture of domestic cat behavior unconstrained by human ownership, coupled with the few existing formal studies of cats in the home, are beginning to provide us with real insight into the social behavior of pet cats. A summary of current knowledge from formal studies of wild, feral, and domestic house cats is provided here in an effort to help veterinarians better understand the social behavior of the cats they see in practice so that they can better advise their clients.

## THE SOCIAL BEHAVIOR OF WILD AND FERAL CAT GROUPS

### Felid Classification: Origins of Behavior

Domestic cats currently are classified as *Felis catus*. Evidence in murals and tombs suggests they were well domesticated in Egypt by 4000 years ago,<sup>2</sup> and recent findings indicate they may have been important companions to human beings as long as 9500 years ago.<sup>3</sup> They are classified in the *Felis* or “domestic cat” phylogenetic group, which is considered fairly old among the Felidae at about 6 million years of age; only the Puma and Lynx lines are thought to be older.<sup>4</sup> Based on morphological and genetic evidence, domestic cats are allied closely with European (*Felis silvestris*) and African wild cats (*Felis lybica*), and all three often are considered subspecies (*F. s. catus*, *F. s. silvestris*, *F. s. lybica*).<sup>4,5</sup> Currently, domestic cats are considered most closely related to the African wild cat, and genetic studies suggest *lybica* diverged from the European wild cat approximately 20,000 years ago.<sup>4,6</sup>

### Wild Cat Behavior and Signaling: Evolutionary Precedents

Little formal research exists regarding the behavior of the African wild cat, at least in part because it is primarily nocturnal and ranges over many habitat types, in many countries. Although some individuals are held in zoos (e.g., National Zoological Gardens, Pretoria, South Africa), little formal research has been performed even on these captive populations. General behavior information does exist, however, and can be found in a variety of sources, most importantly Smithers’ 1983 compendium,<sup>7</sup> the Sunquist’s 2002 volume,<sup>8</sup> and various websites.<sup>6,9</sup> Summaries are based mostly on captive studies or reports of free-ranging, adopted wild cats.

The wild cat does not seem to be particularly social in feeding situations. It rarely is seen in groups even around rich, clumped food sources, such as garbage dumps, where domestic cats often form large groups.<sup>10</sup> However, some evidence shows that mothers provide one another’s young with food, at least in captivity; sharing of caretaking may occur in feral domestic cats, as well.<sup>8,9,15</sup> Home ranges have been measured in at least two studies: one reported a home range of 1 km<sup>2</sup> for one individual in open oak forest on hilly, rocky ground (Israel), and the other reported a home range of more than 1.6 to 4 km<sup>2</sup> for one male cat in Kenya.<sup>8,9</sup> Such variation in home range also is seen in feral domestic cats.<sup>11</sup> The main threat to African wild cats seems to be from hybridization with domestic cats. However, at least one recent genetic study in southern Africa found existing clear genetic separation between wild and domestic cats and advises strong conservation measures to prevent hybridization from increasing.<sup>12</sup>

Bradshaw and Cameron-Beaumont<sup>13</sup> and Sunquist and Sunquist<sup>8</sup> provide excellent summaries of signaling capabilities in undomesticated felids. Although much of the summarized data were based on studies of captive wild animals, behaviors seen commonly in the domestic cat had interesting similarities. This suggests that domesticated individuals already are primed to engage in these behaviors, whether their wild ancestors do so commonly in their natural settings.

In many undomesticated wild felids, urine is emitted through spraying (i.e., primarily by males) or squatting, which often involves foot scraping. Both behaviors also are found in domestic cats. Tree-scratching is widespread among undomesticated and domesticated cats and may function in a number of ways (remove loose claw sheaths, deposit scent, provide a visual signal). Object-rubbing also is typical and observations have suggested at least three distinct functions for this behavior in wild and domesticated cats, including depositing scent (saliva), picking up scent (from previously urine-marked objects), and providing a visual signal of estrus.<sup>8,13</sup>

Acoustic communication varies in pattern across felid groups. Some sounds, such as hisses and spitting, are common in most groups, whereas others, such as purrs and meows, seem restricted, although the difficulty in hearing these quieter calls may affect the ability to study them. Both European and African wild cats in captivity are known to purr, chatter, hiss, spit, gurgle, meow, and give male and female sexual calls (such as yowls), although the data seem more reliable for European cats.<sup>8</sup> Roars seem to be restricted to lions.

Visual signals involve rolling behavior primarily, usually in sexual contexts. However, rolling in wild cats has not been seen in the submissive contexts in which it is thought to occur in domestic cats.<sup>14</sup> Only lions so far have been described with a tail-up signal similar in form to that used so commonly by domestic cats, and the circumstances of use have not been well studied.<sup>13</sup> Body and face signals have not been described for species other than the lion.<sup>13</sup> Tactile signals are seen in many species and may include social rubbing, lying in contact, or allogrooming, although some of these behaviors have been documented only in captivity.<sup>13,14</sup>

### Classic Studies of Feral Cat Behavior

A number of researchers have examined the behavior of feral domestic cats, defined here as domestic cats with little if any deliberate or direct contact with human beings throughout a majority of their lives (in this chapter, this includes strays that were once owned but are now on their own). The study of these cats is helpful because they provide a glimpse into what domestic cat behavior can become when the constraints of living in a human-organized home (e.g., limited space, high densities, forced relationships) are removed and new problems are encountered (e.g., need to hunt for food, find shelter, avoid predators). Because these cats must deal with natural problems of food, shelter, and both interspecific and intraspecific interactions, their behavior often is considered more instinctive or “natural” than those of human-constrained “pets.” They are studied to provide insight into the behavior of domestic cats in the home.

Two excellent reviews on the behavior of feral cats provide a summary of the literature.<sup>10,11</sup> Most recently, Crowell-Davis, et al<sup>15</sup> have combined these works with their own studies of farm cats to provide an excellent overview of behavior in feral groups. They also include a discussion of the implications of these studies for understanding behavior in multiple cat homes.

Macdonald, et al<sup>10</sup> explored free-ranging cat groups, mainly farm cats, and focused on the formation of groups by adult female cats, the dynamics of cat groups, and the relationship between behavior and epidemiology. Their research over a number of years involved more than 3000 hours of observation, including 63,000 interactions and 39,000 measurements

of proximity among individuals in three feral farm cat colonies: one small, one medium, and one large.

Several important points were made in their review.<sup>10</sup> First and perhaps most important, they stressed the relationship between group size and prey size. Group formation in felids in general, including domestic cats, seems dependent in large part on the size of prey that can be captured and the need to fend off scavengers.<sup>10</sup> So, for example, lions working together can take much larger prey than individuals alone and can better resist attempts by hyenas to take over a kill. However, many felids, particularly the smaller ones, do not need to take large prey to gain their necessary food intake and can hunt and eat alone. As would be expected then, feral domestic cats living on wild prey such as rabbits and rodents tend to be solitary, but those with access to clumped food sources related to human activities, such as around barns, landfills, and fishing dumps, live in groups.<sup>10</sup> Clearly domestic cats have a built-in flexibility in grouping behavior and are not restricted evolutionarily to being solitary. However, a trade-off seems to occur: condensing around a rich food resource may lead to an increase in disease susceptibility and the spread of pathogens. Group living may have important limits.

Second, Macdonald et al<sup>10</sup> noted that the feral domestic cat groups that form where food is readily available are not random aggregations; rather, cats favor the company of certain cats and avoid others.<sup>10</sup> Clearly they can recognize one another and form long-term relationships. These seem to be based on age, sex, social status, and bloodlines.<sup>10</sup> Female lineages were found to be the “building blocks” of the feral cat societies that were studied. Lineage groups were formed by adult females and successive generations of their offspring; large colonies had several lineages; smaller colonies had only one or two. Relationships within the lineage generally were “amicable” and groups tended to be hostile to outsiders. Bigger lineage groups tended to occupy the area near the central food resource around which the colony was formed, whereas smaller ones tended to be more peripheral; that is, larger groups of related individuals seemed able to dominate the food source to some extent and their offspring tended to have higher survival rates.

Adult males were not tied to a particular lineage. Some males tended to stay near the central food resource, whereas others tended to roam widely, possibly visiting other groups. This behavior did not seem dependent on bloodlines; some male offspring of lineages stayed near the female group, whereas others did not. Overall, Macdonald, et al<sup>10</sup> found that males roamed more often or over further distances, and females tended to stay near the central food source.

Dynamics among individuals depended on colony size and other factors.<sup>10</sup> Sex, age, and relatedness all seemed to play important roles, but individual identities and other aspects also seemed important. The small study colony consisted of two females of different lineages, their offspring, and one male. In this group, the females tended to stay more than 10 m away from each other but were often within 10 m of the male. They were never seen to be aggressive toward the male but often were targets of his aggression. The females often licked or rubbed the male, despite his aggressive tendencies. In the two larger colonies, males tended to be aggressive toward either adult or juvenile males, depending on which were more prevalent in the population and how many females were the subject of competition. Males did not often interact with kittens in these groups.

Age groups tended to form bonds: kittens tended to interact with kittens and juveniles with juveniles. Relatedness was important: mothers tended to spend time closer to their own offspring than to the offspring of their sisters. Death of an individual may result in unexpected changes; for example, one daughter of a female that died during the study became very aggressive toward two of her sisters but not to a third sister and not to her own two daughters. Clearly, individual adult relationships were complex and based on more than relatedness.

The constraining role of pathogens on group size and dynamics became apparent when Macdonald's group examined epidemiology in a separate, large population (50 to 80 individuals) of feral cats.<sup>10</sup> Pathogens were highly prevalent; 100 per cent of the population showed antibodies to feline calicivirus (FCV), feline rotavirus (FRoV), and feline herpesvirus (FHV). More than half of the group (53 per cent) were seropositive for feline immunodeficiency virus (FIV) antibodies, 96 per cent had antibodies for parvovirus (FPV), about 90 per cent had coronavirus antibodies (FCoV), and 40 to 90 per cent were infected with parasites (*Toxoplasma gondii* more than 45 per cent, *Toxascaris leonina* more than 80 per cent, *Toxocara cati* more than 90 per cent). Use of communal latrines (18 for the 50 to 80 individuals), rat prey populations that could serve as a reservoir for *T. gondii*, and communal suckling and cleaning of kittens were considered possible causes of this high pathogenicity. Clearly group living may have great costs. The benefits of being a central female (close to resources, near daughters and sisters) seem to be offset by the cost of being part of a large group, where infection can enter and spread easily. However, central individuals tended to have fewer mouth infections and wounds, perhaps because they were less likely to engage in fights and may still survive better than those on the periphery.

Liberg, et al<sup>11</sup> examined the role of population density on spatial organization and reproductive tactics in feral cats in a review of more than 30 studies from a number of different sites over a 20-year period (1977-1997). Again, spatial availability of food and its abundance played an important role in behavior. Although domestic cats often are said to be "flexible" in their social system, from solitary to highly social, it is still astounding to see the range of densities in which feral cats have been found, from as few as one cat per square kilometer to more than 2000 cats per km<sup>2</sup>.<sup>11</sup> Individual home ranges were similarly variable: female ranges varied from 0.1 to 200 hectares and male ranges up to 1000 hectares.

Group densities and female home ranges seemed to depend primarily on food abundance and distribution. Where food was plentiful and clumped (such as landfills), densities were high and female ranges small; where food was dispersed, as when hunting natural prey, densities were low and female ranges large. Male home ranges seemed more dependent on the availability of females, especially during mating season. Overall, females in the feral colonies with rich food sources tended to stay in natal groups with little roaming, and those dependent on hunting roamed over much larger areas and were more solitary. Males tended to roam and have overlapping home ranges more often than females.

### Recent Studies of Feral Cat Behavior and Implications for Cat Behavior in the Home

Crowell-Davis, et al<sup>15</sup> attempted to gain insight into housecat behavior through a reexamination of the literature on feral cat

behavior and inclusion of their own studies of farm cats. They used these studies to attempt to understand how to introduce new members to existing groups and the development and treatment of behavior problems, such as "cat bullies" and inappropriate urination and defecation.<sup>15</sup>

Feral cat colonies, according to Crowell-Davis, et al,<sup>15</sup> basically are formed when food is abundant and/or clumped, with affiliative, cooperative relationships among related females forming the core of the group. Cats in these groups can recognize colony members versus noncolony members, and nongroup individuals are not allowed to casually approach and enter a group.<sup>15</sup> Individuals spend time in proximity to specific others, their preferred associates, in a variety of contexts and locations, and associates can be from the same or opposite sex. When individuals in groups are intact and sexually active, males overall spend less time near one another than in groups in which all individuals are neutered, which implies sexual competition, at least between some males. However, gender does not seem to play a role in which cats spend time near each other in feral groups in which all individuals are neutered, which makes it even more clear that individual relationships play an important role in bonding, independent of sex.<sup>15</sup>

Males may be aggressive to one another during female estrus, but that is not always the case, and males also may be preferred associates to one another. Both females and males are polygamous, each seeking out and mating with several individuals of the opposite sex, and individual recognition and familiarity seem to enhance the likelihood of some pairings over those between strangers. Females often aid each other in raising young by grooming, nursing, and guarding each other's kittens and may even engage in "midwifing," when one female aids another during birth. Adults of both sexes seem to play a critical role in defending kittens and helping kittens and juveniles learn appropriate hunting and social behaviors.<sup>15</sup>

Dominance often is considered a confusing topic in cat behavior. Building on definitions from the primate and general behavior literature,<sup>16,17</sup> Crowell-Davis, et al<sup>15</sup> describe a subordinate as an "individual who consistently submits or gives way to another as a consequence of prior experience with that individual, and the animal submitted to is considered to be the dominant in that dyadic relationship." They point out that although some species have truly linear hierarchies of dominance relationships, most animals, including mammals, do not, which makes it difficult to tell in a group who is dominant to whom.<sup>15</sup> Also, although dominant animals can secure resources first or drive subordinates away from resources, they do not always do so. Often subordinates notice a dominant animal and leave a situation before confrontation can occur, which makes it even more difficult for observers to tell what the animals' relationships are.

Cats, then, like most mammals, do not demonstrate explicit linear hierarchies, even in feral groups. They apparently use subtle signals to communicate their intent to take or defend a resource or leave one. These involve a dominant and subordinate staring at each other (dominant) or looking away (subordinate); stiffening the ears and rotating them to the side (dominant) or lowering them slightly or flattening them (subordinate); elevating the base of the tail while drooping the tip (dominant) or curling the tail against the thigh (subordinate); stiffening the limbs (dominant) or lowering the body or crouching (subordinate); and standing upright (dominant) or rolling over (subordinate).<sup>15</sup> These subtleties, coupled with the fact that



dominants do not always exert their control and subordinates often curtail the need for an encounter by avoiding it, make it difficult for observers to recognize dominance relationships in cats readily.

Cats also use sounds for communication in feral groups. These are divided into three useful working categories by Crowell-Davis, et al<sup>15</sup>: those made with mouth closed (purrs, trills), which are seen mostly in greeting situations; those made with mouth open but gradually closing (the typical “meow”), again used mostly in greetings or amicable interactions; and those made with the mouth held open (growls, yowls, snarls, hisses, spits, shrieks), which are used mostly in aggressive situations. Feral cats also have been seen to engage in a variety of other social and signaling behaviors, including nose-touch greetings, allogrooming, allorubbing (usually using head, flank, and tail), play, tail-up as a possible signal of “friendly” intent, and lying in physical contact during rest.<sup>15</sup>

Olfactory communication in feral groups involves glands, urine, and feces. Glands of the head (temporal, submental, and circumoral) are rubbed against objects and other cats. Observation of placement and timing of this behavior has led to the theory that molecules are deposited that identify aspects of the colony and label specific individuals.<sup>15</sup> Although glands are known to exist in the perianal area and between the digits, little is known about their possible social functions. Observing feral cat colonies, it is unclear why cats deposit urine or feces in specific ways (e.g., burying feces in the core area of their home ranges but leaving them exposed on the periphery).<sup>15</sup> Although marking territory has been offered as a possible explanation of urine and feces deposition, Crowell-Davis, et al<sup>15</sup> point out that no evidence exists that cats actually defend territory (i.e., protect a piece of land). However, urine often is used by other mammals, including the larger wild cats, to convey information about estrus, provide location information about individuals and about behavior or “emotion” (e.g., aggression or arousal), and may play these roles in feral cat groups as well.<sup>15</sup>

This examination of feral cat populations includes some obvious correlations to housecat behavior and valuable lessons to be learned. These lessons may be grouped into socialization issues, ability to introduce new animals to a group, grooming issues (petting), and the importance of dominance relationships.<sup>15</sup> In terms of socialization, feral cats have demonstrated the importance of kittens learning from their mothers and others in the group about how to interact with others and with whom to interact; that is, they are “born with the capacity to learn species-specific social skills, but they are not born with the specific skills.”<sup>15</sup> This means that cats that were found or adopted by human beings as young kittens may have missed learning important skills from their mothers. Although this may not be a problem if such a cat is kept as a single pet in the home, or if kittens found together are kept together, it may lead to major difficulties if an owner attempts to introduce a new cat. The less socialized individuals may have difficulty recognizing and using signals of greeting, dominance, or submission and may become extremely aggressive or fearful.<sup>15</sup>

Feral cat colonies also demonstrate cohesiveness, recognition of members versus strangers, and patterns of interaction based on gender, relatedness, and age-related socialization (e.g., female-female relationships, mother-kitten relationships, and groups of kittens growing up together). A group of cats in a home mimic this pattern in many ways; for example, individuals that came into the house together as kittens, whether

related or not, often maintain close relationships, sharing space, and allogrooming one another.<sup>19</sup>

Subsequently, introducing one or more new cats into a stable group can be a major problem. Based on the feral cat research, Crowell-Davis, et al<sup>15</sup> recommend that pet owners who want more than one cat adopt small groups of related or young individuals, such as a mother and two kittens or a small group of related or unrelated kittens, at broad intervals. They also suggest the following: (1) building up some degree of familiarity between the group and any new, strange cat before it can be introduced, as occurs in feral groups, (2) keeping the stranger behind screen doors so odors can be exchanged, and (3) exchanging bedding and materials from resting spots.

Although many others have made these observations based on anecdote and experience, Crowell-Davis, et al<sup>15</sup> use the information gained from the feral cat studies to provide a more scientific underpinning for these suggestions. They believe it is difficult but not impossible for strangers to enter a colony, given enough time, and sight, scent, and sound are the sensory modalities used most readily by cats to facilitate this at a distance (e.g., when a stranger cat cannot get closer without inducing aggression). Surprisingly, they do not provide any recommendations about adoption of related females, a suggestion that may be expected given the importance of female relationships in feral groups.

Rubbing on human beings and human petting of cats resembles typical cat-cat social behavior in feral colonies. Problems can arise if human beings interpret rubbing as seeking further interaction when the cat may be using it only as a passing greeting, or if people pet in areas that usually are not allogroomed by other cats, such as along the back, on the tail or at its base, or on the belly.<sup>15</sup> Although some cats welcome this additional allogrooming, others do not.

Dominance is subtle but important in feral cat colonies and helps cats maneuver in the group. They know whom to approach, whom to avoid, and at what times and places those behaviors will be important. In the home, having a high-ranking cat that does not make an issue over resources unless particularly interested in one at a certain time may result in a peaceful group with little overt aggression.<sup>15</sup> Because signals are subtle and fighting rare in these populations, owners often have a perception one cat is dominant and often can identify it but cannot explain their rationale.<sup>19</sup> However, having a high-ranking cat that often displays classic dominance behavior (i.e., threatening, supplanting, taking resources away from others) may lead to serious intercat aggression, extremely submissive “pariah” cats, and feeding and elimination problems when a dominant cat blocks access to important resources.<sup>15</sup> In these cases, owners can be advised that this is overt dominance behavior, and they may be able to help the situation by working with the contested resources. For example, they may allow the dominant cat to eat first or provide many litterboxes in different locations so that the dominant cat cannot monopolize all of them.<sup>15</sup>

## SOCIAL BEHAVIOR IN THE HOME

Pet cats living in the home are similar to and yet distinct from their wild undomesticated cousins and feral domestic cat populations. Their living conditions provide them with shelter, food, and relief from most predators and disease, but constrain them in terms of the size and density of their living area, kinds

of food available and access to it, access to the outdoors and to appropriate areas indoors in which to eliminate waste (litter-box), and the number and kinds of companions. An additional factor is the removal of reproductive capability that is typical now for most pet cats in the United States.

### Lessons About Social Behavior from Direct Observation of Pet Cats in the Home: Intraspecific Interactions

Although the information gained from studies of undomesticated wild cats and feral domestic cats can provide important context for understanding the behavior of pet cats, it cannot substitute for the insights gained from direct observation of cats in the home. It is clear from in-home observation studies that cats can and do adjust their behavior to deal with the constraints of being a pet. General patterns emerge and are frequently but not universally similar to what may be predicted from studies of feral cats. Individual behaviors and relationships clearly also play an important role, as they do in feral groups.

For example, Bernstein and Strack<sup>19</sup> examined 14 cats living as pets in a relatively small home (approximately 124.5 m<sup>2</sup> or 1340 ft<sup>2</sup>). The seven males and seven females were unrelated and neutered and ranged in age from 6 months to 13 years at the start of the 3-month study (approximately 336 hours of observation). The first finding was that these cats could live relatively peaceably at a density of 0.1 cat/m<sup>2</sup> or 113,000/km<sup>2</sup>, about 50 times greater than the highest densities described for feral groups outdoors (e.g., 2000 cats/km<sup>2</sup>).<sup>20</sup> This suggests that cats are capable of dealing with social “closeness” in the home and do not have to be solitary, although, clearly, single cats can thrive. The 14 cats in the study group seemed to do this through space management, home ranges and favored spots, and tail signaling at a distance. These tactics provided information that could enable recipients to tailor their responses before contact was imminent, and so, for example, avoid aggression. Based on findings for feral cats, availability of resources likely also would be an important factor in behavior determination. This owner provided a food dish for each individual, spread water bowls and litterboxes throughout the house, and provided isolated food, water, and litter for individuals that did not venture far from a specific room because of illness or apparent avoidance behavior. This may have prevented dominant individuals from blocking access to important resources, although that was not tested in this study and was not obvious from simple behavior observation.

Home range was defined as the number of specific rooms used regularly by the cats.<sup>19</sup> Although the entire house was open to all individuals, they did not use all areas. Individuals had overlapping but individually distinct home ranges and males tended to have slightly larger home ranges than females (i.e., used slightly more rooms on a regular basis than females did), similar to feral cat groups. However, home ranges did not seem organized around particular groups of females in any obvious way, as it would be in feral groups with intact females. Ranges seemed determined instead by a combination of individual preference for particular rooms and approach/avoidance behavior between particular individuals. Little overt aggression occurred during the study, so actual fighting did not seem to be important in determining day-to-day movement. However, the oldest male, which also showed classic dominance behaviors of fighting, chasing and supplanting, had the largest adult home

range. The kittens, two 6-month-olds and one 1-year-old, had the largest home ranges of all individuals at the start of the study. They used all 10 of the available spaces on a regular basis, which suggests they were interested in these areas and not prevented by others from entering them. Bernstein<sup>21</sup> demonstrated that home ranges are not determined strictly by interactions with other cats but are at least partly dependent on individual preference. In 68 single-cat households, only about 18 per cent of cats used all rooms available.

Changes occurred in home ranges during the study.<sup>19</sup> The most dramatic involved an adult female that increased her range from one room to four and the three kittens that decreased their ranges by dropping four to seven rooms. These occurred after the male cat that had showed classic dominance behavior died and as the kittens became 1 year old. This suggests that as the kittens developed into juveniles, they began to have preferences for rooms or for individuals and/or were beginning to be limited in some way by the adult cats. It also suggests that the individual relationships between the adult male, the adult female, and the kittens played a role in these changes.

Favored spots, specific areas in a room where cats can be found on a regular, predictable basis, are well known to cat owners but rarely have been studied formally, especially for their social rather than physical aspects (temperature, surface texture). In this group, individuals had either their own unique spots or shared spots with others, either physically or over time (e.g., time sharing, in which one individual used a spot and at a later time another would use the same spot) (Figures 71-1 and 71-2).<sup>19</sup> In this group, physical sharing of spots was rare. However, gender, individual relationships, and developmental relationships seemed important determinants of time sharing of spots: females tended to share spots over time with specific other females, and males with specific other males. Three spots were shared by older females with a male kitten or with an adult male that had started physically sharing with the female when he was a kitten (5 years before). This pattern suggests the cats could determine who was sharing a spot. Despite the lack of genetic relatedness, it mimics findings for feral cats, which also tend to group with specific individuals (preferred associates), usually relatives (sisters and young).

Dominance in this group was clear only in terms of a “top” and “bottom” position: one individual male displayed classic dominance behaviors and one displayed classic subordinate behaviors (i.e., always withdrew as others approached and never controlled resources). No obvious hierarchy existed beyond that and little overt aggression occurred. After the male that displayed classic dominance behaviors died, no obvious dominant cat emerged. However, the owner felt that the next oldest adult male became dominant. The only evidence in this study was elusive: this individual seemed able to go wherever he wanted and eat whenever he wanted and had the largest remaining adult home range (used the greatest number of rooms on a regular basis). He also was the first to enter an empty cardboard box that was presented as a “treat” to the cats during the study. All others waited until this male left the box before they entered.

The tail-up position was seen most frequently and coincided with individuals gathering information, monitoring the approaches of others, or approaching others and beginning nonaggressive interactions.<sup>19</sup> This seems similar to information reported for feral cats.<sup>15</sup> This tail position is seen easily and could “tag” an individual as one monitoring others and likely to engage





A



B

**Figure 71-1.** A and B, Tiger and Smokey have unique “favored spots” in the home where they regularly spend part of the day sleeping and grooming.

in nonaggressive interactions. This allows others to decide at a distance whether to approach for further interaction. Detailed video analysis would be necessary to test this impression.

Barry and Crowell-Davis<sup>23</sup> examined the behavior of two-cat dyads in 60 homes, 20 of each gender combination, 10 hours each pair. All cats were neutered and considered indoor-only. They found less aggression and more affiliative behaviors and time spent in proximity than they had expected, with only 68 cases of aggression over the 600 hours of observation. Aggression seemed more related to individual relationships than to gender, age, or population density (size of home). Cats spent an average of 35 per cent of their time in close proximity (within 5 m) and male-male pairs spent the most time in close proximity, 0 to 1 m. This seems to contradict findings for feral cats, in which females are most likely to form groups. What is most valuable to note is that despite the limited spatial range and the forced proximity as indoor-only cats, all pairs were capable socially, able to manage their behavior in time and space with a minimum of aggression.



A



B

**Figure 71-2.** A and B, Tiger and Smokey have several “favored spots” that they also alternate. Here they are each shown using the same chair at different times of day.

Clearly more studies are needed to allow broader patterns to emerge and provide a formal basis for understanding the behavior of single cats and groups in the home.

### Lessons About Social Behavior from Examination of Human-Cat Interactions in the Home: Interspecific Interactions

Although intercat relationships are of primary importance in feral cat groups, relationships with human beings are critical for cats in the home. Obviously, human-cat interactions are important to cat survival, but they also are a social challenge for the cats and provide them with a new set of interactions they must learn to accommodate and affect cat-cat interactions. Issues of socialization, differences among breeds, general interactions (e.g., feeding, petting, sharing physical contact, letting cats outside or not), and communication are important in understanding cat behavior in the home and have been addressed by a number of researchers.

## Socialization

Socialization to human beings clearly is important for cats that live in a home. If they do not interact well with people, the resulting problems could affect how and when they are fed, cared for, and interacted with, and ultimately whether they will be able to continue living in the home. Most studies have focused on kittens and indicate that a key period occurs between 3 and 7 weeks and that socialization of kittens to people becomes less effective if delayed much beyond 7 weeks.<sup>24</sup> As may be predicted from feral cat studies, kittens seem to socialize to human beings better if their mother is present.<sup>24,25</sup> Less obvious are studies that find that paternity may play a role in socialization; that is, that kittens with fathers that were friendly to human beings are more likely to be friendly than kittens whose fathers were less friendly to human beings.<sup>25-27</sup> The suggestion is that kittens inherit traits that make them more or less friendly or perhaps more or less bold and therefore more or less willing to approach this large, novel object for interaction. The importance of individual responses to novel stimuli, independent of their dominance ranking, was supported by findings that individual cats that were high ranking in terms of social dominance (unrestricted movement) or object dominance (food or other objects) were not always the least fearful or most likely to approach novel stimuli, whether the cats were indoor restricted or free-ranging outdoor cats.<sup>22</sup> This study supported the contention again that individual differences play important roles in behavior and that domestic cat group structure depends on the individual characteristics of the members, a point supported by feral cat studies and the studies of cat behavior in the home discussed in the previous section.<sup>15,19,21,23</sup>

Handling of kittens by human beings plays a role in socialization, especially when contact includes talking.<sup>25-28</sup> However, handling studies also reveal that some kittens seem resistant to change in their original types, and some friendly kittens remain friendly, whether handled or not, and some fearful kittens remain so despite handling. Certainly this finding is supported anecdotally by the many instances of people taking in feral kittens and raising them successfully as pets.

An overall scheme developed by Mendl and Harcourt<sup>29</sup> illustrates how complex interactions among a number of critical parameters seem to be important in the expression of "friendliness to human beings." Parameters included early social experience with mother and siblings, paternity, breed, coat color and other genetic aspects, maternal care, duration and quality of interaction with human beings (and probably timing and context), and environmental complexity. Based on this and other studies, Siegford, Walshaw, Brunner, et al<sup>30</sup> have developed a relatively quick, simple, and reliable test of cat temperament for adult cats and kittens in an effort to help veterinarians, shelter staff, and others assess "cat sociability, aggressiveness, and adaptability" more effectively for better treatment or adoption placement. However, few studies have assessed how or why human-cat socialization may change over time, especially for adults. That is, even though anecdotal evidence for certain kinds of change in social behavior is abundant, we know little about why seemingly well-socialized friendly cats may become less friendly to human beings over time or are unfriendly to particular individuals, or why unfriendly, poorly socialized cats become more friendly over time.

## Breed Effects

Only a few studies have examined the influence of breed on human-cat interactions. Mendl and Harcourt included it in their scheme of factors that affect socialization.<sup>29</sup> However, most studies deal with subjective ratings of character differences among breeds and seek to link behavior differences with human needs and expectations for a pet.<sup>31,32</sup> However, Turner conducted a study that combined people's subjective assessment of breed traits with direct observations of those same people interacting with their own cats of those breeds.<sup>33</sup> He found that differences in ratings were supported by differences in actual interactions. People rated Siamese and Persian breeds as more socially interesting, better behaved, and more interactive than nonpedigreed cats. These assessments were borne out by direct observation of how the responders interacted with their own pets. This suggests that selective breeding has resulted in breeds that are more predictable in their behavior and therefore better able to be assessed by owners for their value as pets. However, little work has been done beyond this, and feral cat studies do not provide any additional information; pedigreed cats rarely are mentioned.

## Human Effects

Some experimental studies have examined the influence of the person on human-cat interactions. Women tend to be more involved in the care of cats than men<sup>25,34</sup> and tend to approach cats differently, which results in different responses by the cats.<sup>35</sup> For example, when cats were introduced into a room in which a stranger man, woman, boy or girl was seated, human interaction made no difference in the cats' reaction. The cats were likely to approach or not at equal rates. However, they reacted differentially to people depending on how people approached them. Men tended to stay seated, whereas women usually went down to the level of the cat, which resulted in more positive interactions. Children tended to approach rather than wait for the cat to approach them, but boys usually followed the cat if it attempted to retreat, which resulted in less positive interaction.<sup>35</sup> One study examined attitudes of elderly versus young cat owners and found that elderly cat owners seemed more accepting of the "independence" of their cats than younger adults. These findings may be useful to veterinarians and shelters in several ways. For example, discussion about care may best be held with the adult female of a household, evaluation of behavior problems may include questions about the behavior of children or adolescents in a home, or men may be advised to approach and interact more with cats if problems occur. Shelters may use such information to make more appropriate matches between cats and people (e.g., perhaps matching an aloof cat with an elderly man living alone who is more likely to accept its independent nature).<sup>30</sup>

## Direct Observation of Human-Cat Interactions in the Home

Although the most obvious way to answer questions about human-cat social behavior in the home would be to observe human-cat interactions there, surprisingly few studies have done so. Mertens<sup>34</sup> demonstrated the complexity of human-cat interactions as they occur naturally in the home. In this study, she observed 72 cats interacting with 162 people over a 12-



month period, in sessions lasting 210 minutes each. She attempted to reduce observer effect by acting like a normal visitor to the house, such as talking with owners and sitting and standing in rooms as a visitor might, although she did not interact with the cats. She was able to examine the social events engaged in by the people and their cats, including proximity, approach/withdrawal, and initiation and duration of interaction.

Generally, interaction levels were low and most interactions were of fairly short duration (1 minute or less). Single cats tended to stay closer to owners for longer periods of time and have more interactions with owners than did multiple cats. Human beings tended to make close approaches (within 1 m) to the cat more often than the reverse, but when the cat did initiate a close approach, person and cat stayed within 1 m for longer periods of time. Adults and children interacted differently with the cats. For example, adults vocalized toward the cat earlier in an interaction and for longer periods, whereas adolescent human beings (11 to 15 years of age) spent the least amount of time in close proximity to the cats and had the least amount of interaction. Gender played some role: women spent more time interacting with cats than men, but this was partly because women in this group were home more. These findings may serve as “norms” for practitioners; variations from these “norms” (e.g., adults working long hours, leaving adolescents home alone with pet cats for long periods) may result in problems. These may be resolved fairly readily with appropriate advising; for example, a practitioner may suggest the adolescent be taught to approach and talk to the cats periodically, rather than to follow them around or ignore them.

Heidenberger<sup>36</sup> also provided insight into how cats and human beings actually interact by surveying 550 German cat owners. Her results illustrate again that cat-cat interactions alone are not sufficient to explain cat behavior in the home and that people are important additional determinants of that behavior. She found that most owners had nonpedigreed domestic shorthair cats (65 per cent), most of which had been neutered (79 per cent). More than half of the households had more than one cat (59 per cent), with an overall average of 2.2 cats per home.

Although the average number of people in the home was similar to that of the number of cats (2.3), only an average of 1.8 of those people actually dealt with the animals; that is, not everyone interacted with the cats on a regular basis.<sup>36</sup> Women tended to take care of the necessary chores such as feeding and caring for the animals while men tended to play with them. Cats were handled (e.g., played with) on average about 2.5 hours per day, although they were alone an average of 6 hours per day. The average cat in this group was restricted to 34 m<sup>2</sup> of space, rather than having the run of the house. They had an average of five resting places (favored spots) and the owner’s bed was the most frequently mentioned resting place; no information was provided about sharing of places. Only 14 per cent of cats were allowed outdoors without restriction. Another 29 per cent were allowed out with restrictions on where they could go and for how long. About half of the cats (51 per cent) were reported as liking to play mostly with other cats, whereas about 29 per cent preferred playing with their owner and an additional 18 per cent seemed to prefer both equally. Only a few of the cats were reported to prefer to play with a dog or a child.

Owners complained of having problems with the cats, that is, behaviors they would like to change.<sup>36</sup> Owners differed in what they considered problems. More than 600 responses about

problems were related to just four problems: anxiety states (such as running from visitors and hiding, disliking to be touched by owner, fearing children; mentioned for 197 of 1177 cats), scratching on furniture (179), feeding problems (such as eating fast, overeating, continuous seeking and begging for food, or need for special food [128]), and aggression problems (124), with inappropriate elimination running close behind (96).

In general, the family situation and quality of the relationship were related to the frequency of problem responses.<sup>36</sup> Somewhat surprisingly, those without children complained more often about their cats than did those with one to three children, and less surprisingly, people who interacted with their cats for several hours, spread evenly over the day, and experienced owners (who had had at least four cats before) complained less often about problems. Cats kept in groups of two or three or allowed out only rarely or only in good weather were reported as having more problems than others; single cats or cats in large groups and cats allowed out whenever they wanted or at least regularly (two to three times per week or all weekend) had significantly fewer problems. Clearly, cat-cat interactions, human-cat interactions, and owner and cat perceptions play important roles in the overall evaluation of cat behavior in the home.

In addition to these studies, applied animal behavior practitioners have compiled a wealth of data about cat behavior in the home, problems that arise in specific situations, and a variety of treatment and prevention plans based on their practical experiences. Much of this information has been published in brochures and videos,<sup>37</sup> in online website newsletters,<sup>38</sup> or in popular books for the general public.<sup>39,40</sup> However, little has been published as research studies with formal data analysis, which makes it difficult to assess the material or recognize patterns that could be used for treatment. Published material also is scattered, which makes it difficult for other practitioners to access and use when advising clients.

### ***Additional Human-Cat Interactions That Affect Cat Behavior***

A number of other important behaviors occur between human beings and cats that affect cat behavior in the home, including providing cats with access to the outdoors, feeding cats, dealing with cat litter, petting cats and other physical contact, and human-cat communication. Allowing cats access to the outdoors has become controversial in the last decade or so, especially in the United States. A number of pressures have resulted in a sharp increase in owner restriction of cats. For example, research suggesting that cats are highly efficient predators with the ability to decimate wild bird populations<sup>41</sup> resulted in the call by many humane organizations,<sup>42</sup> wildlife conservation groups,<sup>43</sup> and ornithological associations<sup>44-46</sup> to ban cats from the outdoors. These conclusions have been tempered<sup>47,48</sup> by newer findings that such decimation has been demonstrated clearly only on island populations, where highly constricted habitat and high density of prey exist and that cat age and home setting (rural versus urban) are important factors that affect hunting (see Chapter 74). However, the belief that cats are a menace has persisted.

Other problems also play a role in owners limiting cat access to the outdoors, including increasing risk to cats from their own predators (raptors and coyotes, especially in Western and New England states); the growing volume of vehicular traffic; com-

plaints by neighbors about roaming cats; an increase in infectious and often lethal diseases (e.g., FIV infections, feline leukemia virus infection, and feline infectious peritonitis); owner fear of zoonoses despite lack of evidence to support common transfer of disease between cats and human beings (including toxoplasmosis); and the growing population of feral cats that could result in increases in cat fights, cat bites, and transfer of disease to household cats that encounter them.<sup>50,51</sup>

Concerns about these issues seem to be having an impact. In a preliminary survey of cat owners in the United States from 1993 to 2003 (mode = 1997) of 256 households with 503 cats (single and two-cat households), Bernstein found that 50 per cent of cats were being kept indoors at all times, a dramatic increase.<sup>51a</sup> Of those allowed outdoors, only 33 per cent were unrestricted, with an additional 15 per cent allowed outdoors with restrictions, such as sitting with owners on decks, being walked on leashes, kept in the yard on a lead, or kept in small fenced-in areas. These findings are similar to those of Heidenberger,<sup>36</sup> who surveyed German cat owners during a similar time period, in which 55 per cent reported that cats were allowed to “run free” in various ways and frequencies, including some restriction outdoors.

These figures are in sharp contrast to those released by the Feline Advisory Bureau<sup>48</sup> (FAB) from a survey of 1853 British cat owners in the early 2000s, in which 75 per cent of cats were allowed out at will during daylight hours, although only one third of these were totally unrestricted. The FAB survey also found that hunting by cats was likely to have much less effect on prey populations than estimated previously<sup>41,43,48</sup>; only about a quarter of cats were said to hunt regularly (determined by direct observation or from prey being brought in), and hunting activity was most prevalent only in young cats, peaking between 4 and 7 years of age and decreasing dramatically in older cats (which were 60 times less likely to hunt than 2-year-olds). Further, cats in rural homes were almost twice as likely to hunt as cats in urban settings, again decreasing the estimates of the number of prey being taken.<sup>43,48</sup>

Missing from this discussion are formal studies of whether cats kept primarily or fully indoors are more prone to develop behavioral and other problems. Aside from the surveys by Heidenberger<sup>36</sup> and FAB,<sup>48</sup> few formal sources of information exist regarding this issue. Both studies found that owners were more likely to complain of problems if cats were kept indoors or only rarely or irregularly allowed outside. In the FAB survey,<sup>48</sup> cats that were not allowed outside were one-and-a-half times more likely to exhibit indoor toileting problems and more than twice as likely to engage in indoor spraying. Applied behavior practitioners and anecdotal sources are additional important sources of information about this issue, especially in providing treatment guidance based on experience. But the information must be sought out.

Although a large literature exists on diet and nutrition aspects of pet cat care, few studies have observed human-cat interactions directly at feeding times, including initiation of the event, coordination, and ending. Because getting food from owners is an important aspect of pet cat behavior, especially if cats are kept indoors, it would seem critical to examine how cats and people manage this interaction, where communication and manipulation by one or both parties may play important roles. Bradshaw and Cook<sup>49</sup> observed the behavior of 36 cats during feeding to gain an overview of cat behavior in this setting and the role of cat personality. Not surprisingly, cats

spent much of the premeal period interacting with the owner and using communication signals such as meow, tail-up, and rubbing. Much of the post-meal time was spent grooming, with much less interaction with the owner. Human behaviors were not studied, however, and coordination was not examined.

Another human-cat interaction that affects cat behavior in the home is petting. Although cats allogroom one another and people touch one another, petting is a human-cat interaction in which both parties must find ways to modify species-typical behavior. Both parties seek the interaction and therefore must enjoy it. But few studies have examined directly how the interaction is initiated, maintained, and ended. Instead, various pieces have been examined. Some studies have focused primarily on areas of the body petted most often by human beings or that seem preferred by the cats,<sup>52,53</sup> with some examination of the behaviors cats used to initiate the interaction (Figure 71-3). A group of studies also sought to determine what owners gain emotionally from petting their cats; that is, whether petting provides emotional support for people by elevating their mood as it seems to in human-dog interactions.<sup>54-56</sup> Results indicated that cats seemed to help decrease negative mood but did not seem predictably to put owners in a good mood.<sup>24,54,56</sup> Some information about initiation of petting by both parties also was provided. At least one study dealt with duration of the interaction and found most were less than a minute.<sup>34</sup> Because petting can be a strongly positive or somewhat negative interaction for people (i.e., when it results in cat aggression),<sup>57</sup> more research about this interaction and its affect on cat behavior in the home would be beneficial.

Although much has been written about providing cats with litterboxes (size, shape, type and amount of litter, number and placement of boxes), few formal studies have been performed regarding the ways human beings and cats interact over this issue, and how it affects cat behavior ultimately in the home. Because inappropriate elimination is a major complaint of cat owners and often is given as a reason for relinquishment, studying this issue more directly would seem critical. Also, contact-seeking behavior other than petting (e.g., sleeping with owner,



**Figure 71-3.** Petting is one of the most common interactions that occur between cats and human beings, but few formal studies of this interspecific activity have been conducted. Although petting often seems to involve areas that are allogroomed commonly by other cats, and hence may resemble cat-cat interactions, some petting activity seems specific to human-cat interaction. Here Tiger is petted on the lower abdomen, an area for which she often solicits petting and during which she remains in place and does not scratch or bite. This area usually is not allogroomed by other cats and usually not favored by most cats during human petting.

sitting on owner's lap, owner picking up cat) has not been studied and also may play an important role in cat behavior, especially in multicat homes in which competition may exist for the resource of "owner attention." Further, although some research has focused on introduction of new cats to cats already occupying a home,<sup>15</sup> little work has been done on problems that involve introduction of new cats to the human beings in the home, or introduction of a new person to the home. Further, almost no one has investigated what occurs when a human being in a home dislikes cats in general or one cat in particular but must deal with them or when a particular cat dislikes a particular person. How cats and people interact may have an impact on how cats interact with each other.

Signaling between owner and cat also could contribute to owner-cat difficulties if communication goes badly, but this subject has not been well studied. A preliminary experimental study indicated that human beings interacting with a strange cat in a neutral room talked to the cat using language similar to child-directed speech and apparently modified their speech to match the perceived comprehension level of the listener.<sup>58</sup> However, no studies have attempted to directly observe human-cat "conversation" in the home, as either or both vocalize to one another in attempts to communicate. None have examined if and how cats may modify their vocalizations when engaging people versus other cats. None have examined whether cats use or modify tail signals during interaction with human beings.

Some studies have examined cat vocalizations directly and attempted to parse them by context to decipher messages or meanings.<sup>13,59-61</sup> A few studies have examined human perception of cat vocalizations, to see if recognizable categories were shared by person and cat (i.e., could human beings classify them into the contexts in which they were given).<sup>61</sup> People were just barely able to classify the calls, being slightly above chance levels. Not surprisingly, experienced owners were somewhat better than those with less experience, but they, too, were only somewhat better than chance. This suggests the calls have low predictive value or people have not learned them well. A related study demonstrated that human beings could classify wild cat and domestic cat vocalizations in emotional terms (e.g., pleasant, unpleasant) and discriminate reliably between them on that basis. These observations suggested that some physical aspects of domestic cat vocalizations (e.g., frequency, sound quality) may have been selected adaptively to elicit positive responses from people.<sup>62</sup>

Sometimes the human-cat relationship goes terribly wrong, which results in behavior problems, abuse of various kinds (see Chapter 73), hoarding, relinquishment, or abandonment. Growth in interest and research in these topics has been explosive in the last decade. Major veterinary societies have suggested strategies, set policy, and formed consortia to investigate these issues further.<sup>63-65</sup>

## SUMMARY

Although studies of wild cats and of feral domestic cats can be helpful to predict expectations of cats in the home and management of them, pet cats have a number of different challenges with which to cope. Most important of these are the various constraints imposed by home living and the human-cat interaction itself. Studies of feral cat behavior have provided important background for understanding domestic cat behavior in the home. The few existing formal studies of cat-cat interaction in

the home, and many more applied behavior case studies and anecdotes are providing a more direct understanding. Studies of human-cat interaction are beginning to provide an understanding of that aspect of pet cat behavior. Combining information from all of these approaches, such as finding that flexibility in group size and a keen awareness of individual identity and relationships are important aspects of cat behavior, is crucial to a more informed understanding of cat behavior in the home and to providing advice to owners on how to best care for their cats.

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